REMARKS

Claims 23-34, 38-50, 52-54 and 56-57 are pending.

New Claim 56 recites Cu lower level from Claim 23 and Cu upper level from Claim 39, Mn from Claim 53, Mg lower limit of 1.6 supported by Example 2 at 1.61 and an Mg upper limit of 1.7 from Claim 41, Si from Claim 43, and Fe from Claim 53. Thus, Claim 56 closely tracks Alloy 1.

New Claim 57 is the same as Claim 56 except the silicon lower level is from Claim 23 and the silicon upper level is from Alloy 1 of Table 1 of the present specification. Thus, Claim 57 closely tracks Alloy 2.

No new matter has been introduced by the amendments to the claims.

I. 35 U.S.C. §103

A. Cassada III (US 5,593,516)

Claims 23, 24, 26-30, 32-34, 38-50, and 52-54 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Cassada III (US 5,593,516)(hereinafter "Cassada").

The Office Action asserts Cassada teaches an aluminum based alloy sheet (typically 0.400 in. thick, col. 7 line 16) with 2.5-5.5% Cu, 0.1 - 2.3% Mg, up to 0.15% Fe, up to 0.10% Si, up to 0.20% Zr, up to 0.05% Ti (Cassada claims 1,2,6) which overlaps the presently claimed alloying ranges of Cu, Mg, Si, Fe, Mn and Zr (cl. 23, 38-41, 45, 50, 52-55)." The Office Action also asserts, "Cassada teaches that Zr replaces Mn as a grain growth and recrystallization inhibitor in said composition (column 5 lines 57-61), because Mn lowers the fracture toughness". Thus, the Office Action asserts "[b]ecause Cassada teaches a process of working and heat treating an Al-Cu-Mg alloy that overlaps or touches the boundary of the presently claimed alloying ranges, then it is held that Cassada has created a prima facie case of obviousness of the presently claimed invention." Thus, the Office Action asserts there is an overlap with the presently claimed alloying ranges, including up to 0.10% Si (up to 0.25% Si in Table 1).

1. The Present Invention Has Combinations of Cu and Mg Levels Prohibited by Cassada

The present invention achieves unexpected results by selecting an Al-Cu-Mg alloy with

no Mn, no Zr and the presence of Si. Cassada teaches away from the presently claimed combination of copper and magnesium levels.

The invention disclosed and claimed in Cassada is directed to the control of the level of copper and magnesium in the aluminum alloy below the solid solubility limit for these elements in aluminum (see Abstract). The Abstract discloses the alloy consists essentially of 2.5-5.5 percent copper, 0.10-2.30 percent magnesium, with minor amounts of grain refining elements, dispersoid additions and impurities and the balance aluminum. However, the broad range of Cu cannot be used with the entire broad range of Mg.

Cassada discloses, "The amounts of copper and magnesium are controlled such that the solid solubility limit for these elements in aluminum is not exceeded." (Abstract; See also col. 4, first paragraph). This is accomplished by using copper and magnesium only in the portion of the Figure 1 between the Solid Solubility Limit and the Alloy Composition Lower Limit.

As explained in the concurrently filed Rule 132 Declaration, these limits are defined by formulas, namely those disclosed by Claim 1 and col. 4 of Cassada.

Cu max = -0.91 Mg + 5.59; and

Cu min = -0.91 Mg + 4.59.

Using the solubility equations results in calculations as follows:

Amended Claim 23 recites 4.3 - 4.9% Cu and 1.5 - 1.8% Mg;

Cu max = -0.91 (1.5) + 5.59 = 4.22%; and

Cu min = -0.91 (1.8) + 4.59 = 2.95%.

Thus, for the recited Mg level there is no overlap of the Cu level of Claim 23 with the permitted Cu range of Cassada.

Cassada, cols. 3 and 4, explains why this control is necessary. For example:

> "The aluminum-based alloy of the present invention consists essentially of 2.5-5.5 percent by weight copper, 0.10-2.3 percent by weight magnesium, and the balance aluminum, and wherein the total amount of magnesium and copper is such that the solid solubility limit of the alloy is not exceeded."

(Col. 3, lines 20-26).

"In one aspect of the invention, the aluminum-based alloy has the major solute elements of copper and magnesium controlled such that the solubility limit is not exceeded. In this embodiment, an alloy is provided having higher toughness than prior art alloys as a result of a lower volume percent second phase (VPSP) due to lower copper content.

It has been discovered that combinations of both high strength and high toughness are obtained in the alloy of the present invention by controlling the range of composition of the solute elements of copper and magnesium such that the solid solubility limit is not exceeded. As a result of this controlled compositional range, an inventive alloy is provided with levels of strength comparable with those of prior art alloys but with improved fracture toughness or damage tolerance.

For the inventive alloy, the high strength and high toughness properties are based upon maximizing the copper and magnesium additions such that all of the solute, i.e. copper plus magnesium is utilized for precipitation of the strengthening phases. It is important to avoid any excess solute that would contribute to the second phase content of the material and diminish its fracture toughness. In theory, the maximum solute level, copper plus magnesium, should be held to this solubility limit. This limit is described in weight percent by the equation:

(1) $Cu_{max} = -0.91(Mg) + 5.59$

Therefore, an alloy containing 0.1 weight percent magnesium can contain 5.5 maximum weight percent copper without producing undesirable insoluble second phase particles. Similarly, at 2.3 percent by weight magnesium, the maximum copper would be 3.5 weight percent.

In practice, the solute levels must be controlled to just below the solubility limit to avoid second phase particles. This level of control must be done as a result of conventional processing techniques for making these types of alloys. In

> conventional casting of these types of alloys, microsegregation of copper in the ingot results in local regions of high copper content. If the bulk copper level is close to the solubility limit these regions will exceed the solid solubility limit and contain insoluble second phase particles."

(See Col. 3, line 51 - Col. 4, line 27).

Moreover, Cassada's discussion of Sample 6 in its Tables 2 and 3 shows Cassada teaches away from the present invention. It is respectfully submitted Sample 6 of Cassada is the closest example of Cassada to the presently claimed invention. Sample 6 of Cassada has 4.91% Cu level and 1.61% Mg, The 4.91% Cu is essentially at the upper end point of present Claim 23 and the 1.61% Mg is within present Claim 23. Cassada, at col. 8, lines 1-3, states this Sample 6 "[C]ontains excess copper…falls outside of inventive alloy copper range for 1.5 wt % magnesium alloy" and has "Toughness too low."

Thus, Cassada teaches away from the combinations of Cu and Mg levels of Claim 23 and the other above-mentioned claims which recite Cu above that permitted by Cassada when coupled with the recited Mg ranges.

Moreover, as explained below, the examples in the present application show an alloy within the scope of claim 23 gives superior properties compared to a conventional AA2024 alloy.

2. The present invention has unexpected results

The Office action has asserted no evidence has been shown of unexpected results to overcome a prima facie obviousness rejection.

However, applicants respectfully submit there is no prima facie case of obviousness because Cassada teaches away from the presently recited Cu and Mg ranges as explained above. Cassada's broad ranges of Mn, Zr, Si and Fe fall both inside and well outside the scope of the ranges of present Claim 23 and its dependent claims and, in view of Cassada's required formulas, its Mg and Cu are outside the presently claimed ranges.

Furthermore, Cassada does not teach the critically of the amounts of Mn, Zr and Si both inside and well outside the presently claimed ranges for achieving applicants' unexpected improved results over AA2x24 alloys. Cassada does not give any direction to one skilled in the art how to relate the amount of Cu and Mg required in his invention with the amount of Mn, Zr, Si, and Fe to obtain the unexpected results of the present invention. In particular, the ranges of Cu and Mg taught in Cassada, as critical for achieving alloys with the claimed high strength and fracture toughness, do not teach the present use of a high Cu content with a very low level of Mn and controlled amounts of Mg, Si, Zr and Fe to achieve applicants' demonstrated improvement over the AA2x25 alloy shown in Table 3 of the present application.

i. Alloy 1 shows the benefit of no Mn with high Si

Moreover, it is respectfully submitted data in the present application shows unexpected results commensurate in scope with at least claim 56.

Alloy 1 of the present invention, at Table 1 of the present application has no Mn and a high Si level.

Page 11 of the present application explains the following:

> "From the results of Table 3 it is clear that the lifetime is the better the lower the level of manganese is. By adding silicon the strength levels (as shown in Table 2) increase again while the improvement in lifetime is still considerably high. That means that the improvement in fatigue crack growth rate is significantly higher when manganese levels are low, more or less independent of

the level of silicon. That means that those alloys, especially at lower ΔK-values, have a significant longer lifetime and therefore are very useful for aeronautical applications."

For the Examiner's convenience Tables 2 and 3 of the present application are reproduced below.

Table 2: Tensile properties and notch toughness of alloys 1 to 4 of Table 1 in the L and T-L direction.

	L		T-L
Alloy	**PS (MPa)**	**UTS (MPa)**	**TS/Rp**
AA2024	344	465	1.74
AA2524	338	447	1.99
1	325	451	1.97
2	310	458	2.09

Table 3: Fatigue crack growth rate for all alloys compared with commercially available AA2024 alloy (=baseline).

Alloy	**Cycles between a=5 and 20mm**	**Improvement in lifetime over AA2024**
AA2024	170,694	baseline
AA2524	216,598	27%
1	283,876	66%
2	322,940	89%

Table 2 shows Alloy 2 has unexpectedly high tensile yield strength levels. It is respectfully submitted this is shown by comparing alloys 1 and 2. Alloy 2 is closer to the

invention claimed in Claim 56 than is the closest example of Cassada, namely Cassada Sample alloy 6. Thus, it is respectfully submitted comparing the results of Alloy 1 to Alloy 2 is sufficient to show the advantages of the Claim 56 invention over Cassada Sample alloy 6.

The following table compares AA2024, AA2525, present alloys 1 and 2 of Tables 1-3, and Cassada Alloy Sample 6 as well as present Claims 23, 56 and 57:

TABLE - Chemical composition, in weight %,								
Alloy	**Cu**	**Mn**	**Mg**	**Zr**	**Si**	**Fe**	**Ag**	**Cr**
AA2024*	4.4	0.59	1.51	0	0.05	about 0.06	-	-
AA2524*	4.3	0.51	1.39	0	0.05	about 0.06	-	-
1*	4.4	0	1.68	0	0.25	about 0.06	-	-
2*	4.4	0	1.61	0	0.11	about 0.06	-	-
Cassada Alloy Sample 6**	4.91	-	1.61	0.11	0.02	0.01	0.50	-
Present Claim 23***	4.3 - 4.9	-	1.5-1.8	-	0.10-0.40	0<Fe≤0.10	-	≤ 0.15
Present Claim 56***	4.3 - 4.5	0	1.6-1.7	-	0.23-0.30	0.06-0.10	-	≤ 0.15
Present Claim 57***	4.3 - 4.5	0	1.6-1.7	-	0.10-0.25	0.06-0.10	-	≤ 0.15
* balance aluminum and inevitable impurities ** V 0%, balance aluminum and inevitable impurities *** balance essentially aluminum and incidental elements and impurities, which are at most 0.05% per element, 0.15% total								

It is respectfully submitted Alloy 2 is closer to present Claim 56 than Cassada Sample alloy 6 for the following reasons:

Alloy 2 has Cu 0.1% below the upper end of the claimed range. Cassada Sample alloy 6

has Cu 0.41% above the claimed range.

Alloy 2 and Cassada Sample alloy 6 both lack Mn.

Alloy 2 and Cassada Sample alloy 6 have the same Mg.

Alloy 2 has no Zr (and thus is closer to the impurity level of Claim 56) while Cassada Sample alloy 6 has 0.11% Zr to be above the impurity level.

Alloy 2 has 0.11% Si which is higher than the 0.02% level of Cassada Sample alloy 6 and thus closer to the 0.23% Si lower level of Claim 56.

Alloy 2 has 0.06% Fe which is higher than the 0.01% level of Cassada Sample alloy 6 and thus closer to the 0.06% Fe lower level of Claim 56.

Alloy 2 and Cassada Sample alloy 6 both lack Cr.

Alloy 2 has no Ag (and thus is closer to the impurity level of Claim 56) while Cassada Sample alloy 6 has 0.50% Ag to be above the impurity level. This Ag is an important aspect of the Cassada disclosure. Cassada, col. 5, line 32 says strength increases if silver is added. Moreover, the effect of Ag is shown by comparing Cassada Table 2 alloy samples 3 and 4 which are similar but for Ag levels. Cassada Table 3 shows the silver adds strength to the alloy sample 4 in the T651 temper. In contrast, present alloy 2 and the present claims do not permit Ag. Thus, it is submitted this implies present alloy 2 is closer to the present invention than Alloy sample 6 of Cassada.

Applicant notes Alloy 1 has higher Mg and higher Si than Alloy 2. However, Alloy 1 has unexpectedly better tensile yield strength levels than Alloy 2 as shown in Table 2 due to the increased level of Si in Alloy 1. Page 7 mentions that "Magnesium also provides strength to the alloy product." However, the difference in Mg is only 0.07% from a base of 1.61% and is too small to be the driving force to the increased tensile yield strength levels of Alloy 1 shown in Table 2. In contrast, the 0.25% Si of Alloy 1 is more than double the 0.11% Si of Alloy 2. **[CAN DR. HEINZ CONFIRM THIS?]**

Thus, since Alloy 2 is closer to Claim 56 than the closest exemplified alloy of Cassada, this showing is sufficient to prove unexpected results over Cassada for Claim 56.

Table 3 of the present application shows present Alloy 2 has a significant unexpected

improvement in fatigue crack growth rate over the "baseline" AA2024 alloy which has 4.4 % Cu and 1.51 % Mg (Si of 0.05%). Present Alloy 2 having 4.4% Cu and 1.61% Mg (Si of 0.11%) is outside the 3.12-4.12% Cu range permitted by Cassada's equations for a 1.61% Mg alloy. The "baseline" AA2024 alloy is also outside the 3.22-4.22 % Cu range permitted by Cassada's equations for a 1.51% Mg alloy, but is closer to the respective permitted Cassada Cu range than is present Alloy 2.

As explained at page 11 of the present application, Table 3 shows reducing the level of manganese improves the lifetime. Adding silicon increases the strength levels (as shown in Table 2) while maintaining the improvement in lifetime. Thus, the improvement in fatigue crack growth rate is significantly higher when manganese levels are low, more or less independent of the level of silicon. As a result, those alloys, especially at lower ΔK-values, have a significantly longer lifetime and therefore are very useful for aeronautical applications.

B. Cassada in view of Rioja et al. (US 6,562,154 B1)

Claim 25 stands rejected as being unpatentable over Cassada in view of Rioja et al. Rioja et al. is relied upon as teaching that cold rolling is effective for further reducing Al-Cu alloys into thin sheets, wherein said cold rolling can include intermediate anneals during said cold rolling (column 6 lines 58-60).

It is respectfully submitted that the teaching of Rioja et al. relied upon in the Office action does not make up for the above-described deficiencies of Cassada.

C. Cassada further in view of "Metals Handbook Desk Edition" p. 445-446

Claim 31 has been rejected under 35 U.S.C. §103(a) as being unpatentable over Cassada, as applied to claim 23 above, and further in view of "Metals handbook Desk Edition" p. 445-446.

Concerning claim 31, the Office action acknowledges neither Rioja nor Cassada disclose rolling said alloy to form into thick sheets. The handbook reference is relied upon as teaching that similar AA2024 type Al-Cu alloys can be formed into sheet 0.15-6.3 mm thick or plate 6.3-200 mm thick, depending upon the application.

It is respectfully submitted the teaching of the Metals Handbook Desk Edition does not

make up for the above described deficiencies of Cassada.

II. Conclusion

In view of the above, it is respectfully submitted that all objections and rejections are overcome. Thus, a Notice of Allowance is respectfully requested.

Please charge any fee deficiency or credit any overpayment relating to this Amendment to Deposit Account No. 19-4375.

Respectfully submitted,

/anthony p venturino/

Date: January 16, 2008 By: ______________________

Anthony P. Venturino
Registration No. 31,674

APV/KVW
ATTORNEY DOCKET NO. APV31645
STEVENS, DAVIS, MILLER & MOSHER, L.L.P.
1615 L Street, N.W., Suite 850
Washington, D.C. 20036
Tel: 202-785-0100 / Fax. 202-785-0200